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No. 96-188

In The

# Supreme Court of the United States

October Term, 1996

GENERAL ELECTRIC COMPANY,
WESTINGHOUSE ELECTRIC CORPORATION,
and MONSANTO COMPANY,

*Petitioners,*

v.

ROBERT K. JOINER and KAREN P. JOINER,

*Respondents.*

**On Writ Of Certiorari**
**To The United States Court Of Appeals**
**For The Eleventh Circuit**

## BRIEF OF *AMICI CURIAE THE NEW ENGLAND JOURNAL OF MEDICINE* AND MARCIA ANGELL, M.D., IN SUPPORT OF NEITHER PETITIONERS NOR RESPONDENTS

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24 pp

## TABLE OF CONTENTS


Page

TABLE OF AUTHORITIES ..... i, ii

STATEMENT OF INTEREST OF AMICI CURIAE ... 1

SUMMARY OF ARGUMENT ..... 1

ARGUMENT ..... 2

A. Preliminary Statement ..... 2

B. The Nature of Scientific Evidence ..... 4

C. Epidemiologic Studies of Risk Factors ..... 6

D. General Causation – A Necessary Proxy for Specific Causation ..... 9

E. The Scientific Method ..... 10

F. Peer Review and Publication ..... 11

G. Scientific Uncertainty ..... 13

H. Deciding Causation When There is Scientific Uncertainty – The Appropriate "Default" Position ..... 15

I. Methodology and Conclusion – Can They Be Separated? ..... 15

J. Defining Evidence in Science and Law ..... 16

K. Bringing Science and Law Together – Using Court Appointed Experts ..... 18

CONCLUSION ..... 19

## TABLE OF AUTHORITIES

Page

CASES

*Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993) ..... 2, 13, 15, 18

*Hall v. Baxter Healthcare Corp.*, 947 F. Supp. 1387 (D. Or. 1996) ..... 18

*Hopkins v. Dow Corning Corp.*, 33 F.3d 1116 (9th Cir. 1994), *cert. denied*, 513 U.S. 1082 (1995) ....15, 19

RULES

FED. R. EVID. 104(a) ..... 18

OTHER AUTHORITIES

MARCIA ANGELL, SCIENCE ON TRIAL: THE CLASH OF MEDICAL EVIDENCE AND THE LAW IN THE BREAST IMPLANT CASE (1996).....1, 3

Marcia Angell, *The Interpretation of Epidemiological Studies*, 323 NEW ENG. J. MED. 823-25 (1990) ..... 7

PHANTOM RISK: SCIENTIFIC INFERENCE AND THE LAW (Kenneth R. Foster, et al. eds.1993) ..... 5

CHARLES H. HENNEKENS & JULIE E. BURING, EPIDEMIOLOGY IN MEDICINE (Sherry L. Mayrent, ed., 1987) ..7, 14

PETER W. HUBER, GALILEO'S REVENGE: JUNK SCIENCE IN THE COURTROOM (1991)..... 18

*The Journal's Peer-Review Process*, 321 NEW ENG. J. MED. 837-39 (1989)..... 3

Arnold S. Relman & Marcia Angell, *How Good Is Peer Review?* 321 NEW ENG. J. MED. 827-29 (1989) .... 12

Gary Taubes, *Epidemiology Faces Its Limits* 269 SCIENCE 164-169 (1995) ..... 7



## STATEMENT OF INTEREST OF *AMICI CURIAE*

*The New England Journal of Medicine (NEJM)*, which is published by The Massachusetts Medical Society, has been for many years one of the foremost peer-reviewed medical journals. *NEJM* is published in the United States and distributed world-wide to physicians and scientists.

Marcia Angell, M.D., an editor of *NEJM* since 1979 and *NEJM*'s Executive Editor since 1988, is the author of *Science on Trial: The Clash of Medical Evidence and the Law in the Breast Implant Case* (1996). As an editor of *NEJM*, Dr. Angell has had 18 years of experience in evaluating the validity of medical and scientific studies submitted to *NEJM*. In *Science on Trial* and elsewhere, Dr. Angell has written extensively concerning the criteria that must be met in order to determine that testimony proffered in a scientific area constitutes knowledge developed through the scientific method. A more detailed statement of Dr. Angell's education and experience is appended after the conclusion of this brief.

Petitioners and respondents have consented in writing to the filing of this brief, and their written consents have been lodged with the Clerk.

## SUMMARY OF ARGUMENT

Central to many tort cases is the scientific question: did physical exposure to some substance cause the illness or death of the plaintiff? This Court has charged judges with the obligation of deciding whether or not expert testimony proffered for the purpose of answering the

question of scientific causation constitutes scientific knowledge that should be admitted into evidence. Judges, however, are generally not trained scientists.

In order to determine the admissibility of scientific expert evidence, especially when it is not well established in the scientific community whether exposure to the substance at issue is dangerous, judges should make far greater use of their authority to appoint independent, reputable scientists to assist them in making admissibility decisions. The use of such scientists would significantly increase the likelihood that the scientific evidence presented to juries actually constitutes scientific knowledge and not merely speculations or hypotheses.

## ARGUMENT

### A. Preliminary Statement.

This brief is submitted on behalf of *NEJM* and Marcia Angell, M.D., who speaks as an individual and as *NEJM*'s executive editor. The purpose of this brief is to comment on what constitutes scientific evidence. In *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), this Court required federal judges to be gatekeepers for scientific evidence in the courtroom, to review expert testimony on scientific matters and to admit such testimony only when it is both reliable and relevant. Dr. Angell's job at *NEJM* is analogous. She helps decide what medical research studies are admitted into the scientific literature. Although there are thousands of medical journals, and a medical research study that does not get published in



*NEJM* may be published elsewhere, publication in *NEJM* is widely regarded as an endorsement of quality.

Evaluating medical research is not an easy matter. At *NEJM* it is done by seven full-time physician editors, six part-time physician specialists, three statistical consultants, and one consultant in molecular medicine. In addition, *NEJM* uses thousands of outside peer reviewers who are experts in the subjects under study. Most important, *NEJM's* staff and its reviewers have the salient data from each study being evaluated. See *The Journal's Peer-Review Process*, 321 NEW ENG. J. MED. 837-39 (1989). Even with all this expertise and the data, however, *NEJM* is often not confident of the validity of a study and mistakes are sometimes made that must be corrected later. It is clear, however, that less rigorous and painstaking evaluation would lead to many more mistakes. Courts should be equally committed to separating good from bad science.

This brief discusses (1) the essential features of medical research and describes the way it is evaluated by the scientific community; (2) the differences between the way scientists approach a question of biologic fact and the way courts approach the same question, often with discrepant results; and (3) ways in which the discrepancies in results reached by scientists and courts can be minimized.[1] Amici Curiae do not intend to comment on the particulars of the evidence proffered in *General Electric v.*

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[1] For additional discussion of the topics covered in this brief, *see* MARCIA ANGELL, SCIENCE ON TRIAL: THE CLASH OF MEDICAL EVIDENCE AND THE LAW IN THE BREAST IMPLANT CASE (1996).

*Joiner*. Rather, this case is an example of a type of litigation that underscores the necessity for a better understanding of scientific issues in the courtroom.

**B. The Nature of Scientific Evidence.**

Central to many tort cases is a scientific question: did physical exposure to some substance cause the illness or death of the plaintiff? For example, in this case, the scientific question is whether exposure to high levels of polychlorinated biphenyls (PCBs) caused Mr. Joiner's lung cancer. In some cases, the question of scientific causation may be relatively easy to answer. For example, where a plaintiff proves he or she ingested food contaminated with *C. botulinum*, and has an injury consistent with such ingestion, there should be no substantive scientific question as to causation since the danger of *C. botulinum* toxin is well established. Substantive scientific questions as to causation primarily arise when it is not well established whether exposure to a substance is or is not dangerous. In these cases, what is at issue is not only whether the exposure occurred, but whether it could cause the harm in question. Unless the question of causation can be affirmatively answered, there can be no consideration of liability.

Since the question of whether PCBs cause lung cancer is a matter of biologic fact, it can be answered only through the scientific method. What is the scientific method? In brief, it means formulating a question that can be answered, designing a study that can answer it, collecting objectively verifiable evidence that will address



the question, and drawing only those conclusions supported by the evidence. The ultimate test of the validity of a conclusion is whether it predicts subsequent events. For example, when a scientist reports the development of a hepatitis vaccine, the ultimate test is whether it prevents hepatitis.

Perhaps the most important hallmark of science is its complete reliance on objectively verifiable evidence. That usually means that something must be counted or measured. The reliance on concrete evidence distinguishes science from all other human endeavors. Medical conclusions are no different from other scientific matters, because the human body is a part of nature.

Whether exposure to PCBs causes lung cancer is an example of a particular type of scientific question that requires a particular kind of evidence to answer. Exposure to high levels of PCBs cannot be the sole cause of lung cancer, even if it plays some role, since people not so exposed also develop lung cancer. And exposure to high levels of PCBs do not invariably cause lung cancer, since most people so exposed remain healthy. Thus, the most that could be true is that PCBs *may contribute* to lung cancer – that is, they might be a "risk factor" (something that increases the *chance* of developing a disease). Whether a risk factor is one of several possible causes of a disease or whether it is merely correlated with a real cause may not be known. For this reason, scientists often say that a risk factor is "associated" with a disease, not that it "causes" it. *See* PHANTOM RISK: SCIENTIFIC INFERENCE AND THE LAW (Kenneth R. Foster, et al. eds.1993).

Risk factors can be strong or weak. For example, cigarette smoking is a strong risk factor for lung cancer. This means that smokers have a very much higher chance of developing lung cancer than nonsmokers. The more they smoke, the greater the risk. In fact, people are extremely unlikely to get lung cancer unless they do smoke. Cigarette smoking is so strong a risk factor for lung cancer that we are justified in saying it "causes" cancer, even though we do not yet know exactly how it does so. In contrast, alcohol may be a weak risk factor for breast cancer. The chances of a drinker getting breast cancer, according to some studies, are slightly higher than the chances of a nondrinker, but abstaining from alcohol is unlikely to confer much protection.

It is difficult to prove that something is a risk factor, unless it is a very strong one. The ideal way, scientifically, to prove that something is a risk factor for a particular disease would be to assemble a large group of very similar people and assign half of them (by random draw) to be exposed to the risk factor and the other half not to be exposed. We would then compare what happens to the two groups. Obviously, we cannot do this with PCBs or any other possible risk factor for cancer. Very few, if any, people would volunteer to be exposed to such risks by random draw.

### C. Epidemiologic Studies of Risk Factors.

As a practical matter, observational epidemiologic studies are central to the process of identifying risk



factors for disease.[2] In an observational epidemiologic study, medical researchers do not assign people to be exposed to a potential risk. Instead, researchers observe what happens in those who have chosen to be exposed for their own reasons or who happen to be exposed inadvertently. Then researchers compare the incidence of the disease in these people with the incidence in those who are not exposed. There are several forms of observational epidemiologic studies, but only two are of much value in demonstrating risk factors – cohort studies ("cohort" simply means group) and case-control studies. A cohort study of the possible link between PCBs and lung cancer would start with a group of people who are exposed to high levels of PCBs and a group who are not, none of whom has lung cancer. Researchers would then keep track of the two groups over time to see how many in each group develop lung cancer. If more in the PCB group get lung cancer, it would support (but not prove) the hypothesis that PCBs are a risk factor. Usually the result is expressed as a relative risk, which is the risk in the exposed group divided by the risk in the unexposed group. A relative risk of 1.0 means there is no difference; a relative risk of 2.0 means the exposure doubles the background risk.

In contrast, a case-control study would start with a group of people who already have lung cancer (cases)

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[2] *See* CHARLES H. HENNEKENS & JULIE E. BURING, EPIDEMIOLOGY IN MEDICINE (Sherry L. Mayrent, ed., 1987); Marcia Angell, *The Interpretation of Epidemiological Studies*, 323 NEW ENG. J. MED. 823-25 (1990); Gary Taubes, *Epidemiology Faces Its Limits*, 269 SCIENCE 164-69 (1995).

and a group who do not (controls). After the groups are assembled, the researchers would find out how many people in each group were exposed to PCBs. If a greater percentage of cases than controls had been exposed to high levels of PCBs, it would support (but not prove) the hypothesis that PCBs are a risk factor. In either type of study, the bigger the difference between the two groups, the more likely it would be that PCBs are a risk factor. The most difficult part of epidemiologic studies is making sure the groups are similar to each other in all ways except the possible risk factor (in cohort studies) or the disease (in case-control studies). If they are not, differences may be due to other factors known as "confounding variables."

Cohort and case-control studies each have advantages and disadvantages, but one or the other is necessary to come close to answering the question of whether PCBs are a risk factor for lung cancer. Just finding instances of people exposed to high levels of PCBs who develop lung cancer is not enough to prove a connection because we have to know whether such instances are more common in exposed people than in people who are not so exposed. Lung cancer may well occur in some people exposed to PCBs simply by coincidence.

Nor can we rely on animal studies, since animals may differ from people in their response to PCBs. Other laboratory studies are also unable to answer the question of whether PCBs cause lung cancer. Although laboratory studies are unable to answer the question of whether PCBs cause human lung cancer, they may provide ancillary evidence that an association seen in human epidemiologic studies really represents cause and effect. In



addition, once a link between a risk factor and a disease is established, by epidemiologic studies, animal and other laboratory studies and studies of individual patients may help explain how the connection works. But these studies cannot establish the link in the first place. That must be done by epidemiologic studies.

### D. General Causation – A Necessary Proxy for Specific Causation.

Epidemiologic studies yield information about probable risk factors in populations, not in individuals. They provide information about average risks in the average person in the population. In order to determine causation in an individual, one must know whether there are individual differences in susceptibility, and if so, what they are. In most lawsuits involving disputed risk factors, however, we do not know enough to make any determination of individual susceptibility. It is difficult enough to determine whether PCBs contribute to lung cancer in the population at large; we have no way of knowing whether they contributed in a particular person. That is true of most tort cases involving a risk factor. For this reason, it is usually necessary for general causation to serve as a proxy for specific causation. We simply assume that what is true for the population is likely to be true for the plaintiff. If an exposure doubles the risk on average, we assume it doubled the risk for the particular plaintiff. In very few cases do we have enough scientific information to do otherwise.

## E. The Scientific Method.

How do epidemiologists find the evidence on which their conclusions are based? First, they need to formulate the question they want to answer and design a study that is capable of answering it. The question is usually framed as a hypothesis. "People exposed to high levels of PCBs are more likely to develop lung cancer than other people" is a hypothesis. (For technical reasons, it is usually framed in the negative – "people exposed to high levels of PCBs are *no* more likely to develop lung cancer than other people" – and the researcher tries to prove the "null hypothesis" wrong.) Although this first step in approaching a scientific question seems obvious and simple, mistakes are often made at this point. If, for example, researchers want to know whether high levels of PCBs increase the risk of lung cancer, they need to choose some suitable measurement of exposure to PCBs, such as a high concentration in body fat, and determine whether it is more common in people with lung cancer than in people without lung cancer, all other factors being equal. Since we know that PCBs are not the only possible cause of lung cancer, it is crucial to make sure that other known causes, such as cigarette smoking, are taken into account.

After the study is designed, researchers must collect data. Collecting data means measuring or counting something. This is the concept that many nonscientists are least comfortable with, because it "reduces everything to numbers." "Everything" cannot be reduced to numbers, but some things can and must be. To reach a conclusion about the physical world, we need numbers because they are often the only way that evidence can be expressed.



What is enumerated depends on the study design. When the data are assembled, they must be analyzed appropriately. Often the analysis consists of comparing one set of data with another set to lead to a logical conclusion. Thus, the number of cigarettes smoked and the concentration of PCBs in body fat in people with lung cancer might be compared with the same quantities in people without lung cancer.

The final step in a research study, after the data are analyzed, is to draw the proper conclusions. Just as the first stage of the study (formulating the question and designing the study) is more difficult than it may at first seem, so is the last stage. Interpreting a study is perilous because of the strong temptation to reach conclusions that are more encompassing than the evidence will support. For example, if a study showed that rats injected with PCBs developed cancer, it would be inaccurate to conclude that PCBs cause cancer in people. That conclusion would go far beyond the evidence. The study did not deal with people, and it did not deal with the same type of exposure. Such a study would be useful only in generating a hypothesis that could be tested in people. Mistakes in drawing conclusions are particularly likely when researchers have strong preconceptions about the question they are studying. The conclusions of a research study must be limited to those – and only those – that follow logically and necessarily from the data.

## F. Peer Review and Publication.

In science, the requirement for verifiable evidence must be met, no matter who the researchers are or what

their credentials. Not even Nobel laureates are permitted to base a scientific conclusion on educated speculation. (They can, of course, speculate or hypothesize, but that speculation will not be accepted as evidence unless it is put to the test.) One of the most important protections against unwarranted conclusions is the system of peer review and publication. *See* Arnold S. Relman & Marcia Angell, *How Good Is Peer Review?* 321 NEW ENG. J. MED. 827-29 (1989). Researchers are expected to write up their study in a standardized way, with sections dealing with the methods, results, and conclusions, and submit the paper to a scientific journal. The editors of the journal then send the paper for evaluation by other scientists working in the same field. This process of peer review is the cornerstone of scientific research. (Note that scientists performing peer review evaluate the researchers' study design, technical methods, analysis, and interpretation, not their principles, theories, or hypotheses.)

The reason peer review is so important is that even the most honest researchers cannot be expected to judge their own work dispassionately. They are likely to be enthusiastic about their ideas and, almost by definition, not aware of flaws in the design of their study or the interpretation of their data. The process of interpreting data is seldom clear-cut, and it is easy to be unaware that the data are inadequate to support the conclusions. Without the discipline of organizing and presenting their evidence, and without the criticism and revisions stimulated by the peer-review process, researchers may unconsciously misrepresent their work or exaggerate its importance. *NEJM* seldom publishes a research study that has not undergone substantial revision as a result of the peer



review process. Sometimes the revisions are so extensive that the central conclusion of the study must be reversed.[3]

### G. Scientific Uncertainty.

In addition to the reliance on objective evidence collected in properly designed studies, science is also characterized by its tentativeness. This may seem counterintuitive to nonscientists who may think science is "cut-and-dried." But, in fact, good scientists rarely reach absolute conclusions. Particularly in medical research, certainty is extremely hard to attain. Instead, medical researchers almost always speak in terms of probabilities. When researchers do a study comparing two antibiotics to treat pneumonia, for example, they will express their findings in terms of the probability that one is better than the other. When they look at the link between cholesterol and heart disease, they frame their results in terms of risks, not certainties. Very few studies are by themselves definitive. In general, science should not embrace the conclusions of one research study until it has been confirmed by other, independent studies. Even then, the studies taken together merely add to the probability that

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[3] Because of the importance of peer review and publication, *NEJM* and two other journals submitted an amicus brief to the Court in *Daubert*, which proposed that publication in a peer-reviewed journal be a criterion for admitting scientific evidence in the courtroom. *See* Brief for Amici Curiae *New England Journal of Medicine, Journal of the American Medical Association,* and *Annals of Internal Medicine* in Support of Respondent, *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993) (No. 92-102).

the conclusion is correct, without proving it absolutely. Of course, every aspect of life involves considering probabilities: when we drive to work, for example, we intuitively gauge the probability that an oncoming car will miss us. But scientific research is different in that probability and uncertainty are explicitly considered, measured, and expressed as part of the study. We can rarely absolutely prove a hypothesis, although we can gather enough evidence from enough different studies to make the hypothesis so probable that we can say it is true for all practical purposes.

In reaching a decision about causation, the crucial consideration is the totality of evidence. *See* CHARLES H. HENNEKENS & JULIE E. BURING, EPIDEMIOLOGY IN MEDICINE, ch. 3 (Sherry L. Mayrent, ed., 1987). Each study should be considered as part of a mosaic of information that taken together yields the answer to a scientific question. We are on firmer ground when there are several types of studies of different designs, all pointing in the same direction. If studies reach substantially different conclusions, scientists are very cautious about forming any conclusions at all (except the conclusion that more research is needed). Only when there are many consistent studies, as in the case of cigarette smoking and lung cancer, can we begin to speak of causation. It is very unlikely that any one type of study, let alone a single study in isolation, can prove that PCBs cause lung cancer in humans.



## H. Deciding Causation When There is Scientific Uncertainty – The Appropriate "Default" Position.

It is often said that because science progresses slowly and tentatively and a lawsuit must be settled relatively quickly and definitively, we are justified in rushing the answer somewhat in the courtroom. That may be true, but it raises the question of what the "default" position should be when there is insufficient evidence concerning scientific causation. In science, the burden of proof is on those who assert a link between an exposure and a disease. The burden is the same in the courtroom: the plaintiff must show that the exposure was more likely than not the cause of the harm. (In epidemiology, that translates to a relative risk of more than 2.0.) But in some highly publicized tort cases, that burden has apparently been significantly lessened. Instead of having to show the likelihood that the exposure caused the harm, plaintiffs have only had to show that it *might* have done so. *See, e.g., Hopkins v. Dow Corning Corp.*, 33 F.3d 1116 (9th Cir. 1994), *cert. denied*, 513 U.S. 1082 (1995). Such a result is contrary to the scientific method and would appear to contradict this Court's insistence in *Daubert* that scientific testimony must constitute scientific knowledge. *See Daubert*, 509 U.S. at 590.

## I. Methodology and Conclusions – Can They Be Separated?

What does it mean when different studies come to different conclusions about the same scientific question? Sometimes the discrepancy is relatively minor. Such discrepancies are particularly likely when the risk being

studied is either very small or nonexistent, because confounding variables are then more likely to distort the results even in fairly well-designed studies. But good studies should not produce major differences in conclusions about the same question. When they do, it means that something is wrong, since the studies are trying to discover the same fact of nature. That is why any distinction between methodology and conclusions is artificial. In science, methods and conclusions are inseparable. When the conclusions about a scientific fact are substantially different in two studies, there must be a flaw in the methods of at least one of the studies. By methods (sometimes termed methodology), scientists mean the detailed design, conduct, analysis, and interpretation of a study. Sometimes in law, the term is used very broadly to refer to the general type of study (for example, "animal study"), but such usage is too vague to have any meaning in defining reliable evidence. Animal studies can be reliable or unreliable.

### J. Defining Evidence in Science and the Law.

The most important feature of scientific research is its dependence on objective evidence. No scientific conclusion can be accepted without evidence. This is perhaps the only feature of science that is absolute. The law also depends on evidence, but the term has a different meaning in the courtroom. The opinion of a properly qualified expert witness is considered to be "evidence." Expert witnesses need not, however, produce objectively verifiable data to buttress their opinions, let alone point to a consistent body of research published in peer-reviewed



scientific journals. In a sense, this is the reverse of the scientific method. In science, objective evidence leads to an opinion; in the courtroom, the opinion of an expert becomes evidence. A court's emphasis on the qualifications of expert witnesses is very different from the standards of science, in which *ad hominem* considerations are minimized. Scientists are trained to look at the strength of the data, not the credentials of the researcher. Indeed, some scientific journals go so far as to hide the names of the researchers from the peer reviewers, so that the peer reviewers will not be influenced in their evaluation by the researchers' credentials. The issue is not who the expert is; it is the strength of the evidence.

Associated with the law's emphasis on the credentials of expert witnesses is a highly individualistic view of science. In the courtroom, the testimony of expert witnesses may be based on their own research, published or unpublished. It is sometimes even suggested that an expert witness did unpublished work in preparation for the trial, that he or she reached different conclusions from other research on the subject, and that these conclusions may be relied upon because of the witness's qualifications. It is highly unlikely that such a witness is testifying to scientific knowledge. First, as has been pointed out, a single study is rarely definitive. Second, peer review and publication are so much a part of good science that any unpublished work should be regarded warily. And finally, expert witnesses, no matter what their credentials, should be commenting on the totality of evidence, which they almost certainly have not generated single-handedly. The best that can be expected from expert witnesses is

that they explain the state of knowledge about their subject, most of which will have arisen from the work of others. They should not be expected, nor is it desirable for them, to report solely on their own research. Science is a highly collaborative enterprise that progresses slowly in a stepwise fashion. Scientists who stand alone are usually wrong. *See* PETER W. HUBER, GALILEO'S REVENGE: JUNK SCIENCE IN THE COURTROOM (1991).

### K. Bringing Science and the Law Together – Using Court Appointed Experts.

Since science is a matter of evidence, not a matter of opinion or argument, what is crucial in the courtroom is a scholarly evaluation of the totality of the evidence. In *Daubert*, this Court acknowledged that no one is so lofty or expert that his or her educated speculation is enough to establish a scientific fact. The Court also acknowledged that no jury is so wise that it can recognize reliable science solely by hearing a proffered expert's direct testimony and responses to cross-examination. The Court, therefore, affirmed that judges should act as gatekeepers with respect to the admission of scientific evidence.

Often, a judge could better fulfill this gatekeeper function if he or she had help from scientists. Judges should be strongly encouraged to make greater use of their inherent authority under Federal Rule of Evidence 104(a) to appoint experts to help them review for admissibility the expert testimony proffered by the parties. *See, e.g., Hall v. Baxter Healthcare Corp.*, 947 F. Supp. 1387 (D. Or. 1996) (rulings made with the assistance of experts appointed by court under Rule 104(a) to assist in determining admissibility of



expert testimony) and *compare Hopkins v. Dow Corning Corp.*, 33 F.3d 1116. Reputable experts could be recommended to courts by established scientific organizations, such as the National Academy of Sciences or the American Association for the Advancement of Science. These experts, representing neither side, could evaluate the expert testimony and generally interpret for the judge the current scientific knowledge about the matter at hand. In essence, the scientific community, by relying on its usual methods of research, peer review, and publication, would be helping the judge to fulfill his or her required gatekeeper role of screening testimony for reliability and relevance.

## CONCLUSION

A scientific question can be answered only through rigorous scientific research. There should not be one standard of science for scientists and another for the courtroom.

Respectfully submitted,

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## MARCIA ANGELL, M.D.

Marcia Angell, M.D., is Executive Director of *The New England Journal of Medicine* and Lecturer in the Department of Social Medicine at Harvard Medical School. She is a graduate of Boston University School of Medicine. She trained in internal medicine at the University Hospital in Boston and in pathology at Mount Auburn Hospital in Cambridge, Massachusetts, and the New England Deaconess Hospital in Boston. She is certified in anatomic pathology. Before attending medical school, Dr. Angell, who majored in math and chemistry at James Madison University, won a Fulbright Scholarship to study microbiology at Goethe University in Frankfurt, Germany. She joined the editorial staff of *The New England Journal of Medicine* in 1979 and became Executive Editor in 1988.

Dr. Angell is co-author, with Dr. Stanley Robbins and, later, Dr. Vinay Kumar, of the first three editions of the textbook, *Basic Pathology*. She is also the author of "Fraud, Theft, and Plagiarism," a chapter in the 1994 revised edition of the *Encyclopedia of Bioethics* (edited by W. Reich). As a member of the Editorial Policy Committee of the Council of Biology Editors, Dr. Angell co-authored *Ethics and Policy in Scientific Publication*, published in 1990. She also contributed a chapter on the publication of unethical research to *The Nazi Doctors and the Nuremberg Code* (1992, edited by G. Annas and M. Grodin).

In 1993, Dr. Angell was elected to the Institute of Medicine of the National Academy of Sciences. She was a member of the Institute's Committee on the Responsible Conduct of Research, and she currently serves on its

Robert Wood Johnson Health Policy Fellowships Advisory Board and its newly appointed National Roundtable on Health Care Quality. She served as a Director of the Council of Biology Editors and is a member of the board of Directors of Public Responsibility in Medicine and Research, the Board of Visitors of the Boston University School of Public Health, and the Peer Review Advisory Board of the American Medical Association. In 1996, she was elected to the Association of American Physicians.

Dr. Angell writes frequently for the *Journal* and other publications on a wide range of topics. She has particular interests in health policy, the ethics of biomedical research, the nature of medical evidence, and care at the end of life. Her book, *Science on Trial: The Clash of Medical Evidence and the Law in the Breast Implant Case*, was published in June, 1996, by W.W. Norton & Company.

In its April 21, 1997 issue, *Time Magazine* named Dr. Angell one of the twenty-five "most influential people in America" for 1997.

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